An online urban information system initiative for the Shibuya city

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The computing tools and technologies with urban information systems are designed to enhance planners' capability to deal with complex urban environments and to plan for prosperous and liveable communities. This paper examines the role of Online Urban Information Systems or in another words Internet based Geographic Information Systems as spatial decision support systems to aid local planning process. This paper introduces a prototype Internet GIS model that aims to integrate a public oriented interactive decision support system for urban planning process. This model, referred as a 'Community based Internet GIS', incorporates advanced information technologies and community involvement in decision making processes on the web environment. This innovative model has been recently applied to a pilot case in Tokyo and this paper concludes with the preliminary results of this project.

1. INTRODUCTION

Countless factors affect the inner workings of the city, so in an attempt to gain an understanding of place, planners try to examine aerial photographs, engineering plans, census data, economic studies, transportation systems, etc. Geographic Information Systems (GIS) have been used as a way for organizations to create, manage and analyze spatially referenced data in highly structured ways. Various cities in the world have been developing GIS, which have the ability to map a city and include a substantial amount of geographic and spatial data in the system.

Municipalities which have invested great amount of money and countless hours of labour in setting up their GIS files, for the most part, used to not want to give the information out free with minimal costs. But nowadays some of the local governments have started to understand the importance of public participation in environmental and urban planning issues. In the course of time public opinions and feedback have started to gain more importance in local governance. Regarding to this increasing importance, some of the local governments began to share their Urban Information Systems (UIS) with the public.

One of the elements that many UIS have in common is that they utilise GIS. One of the obvious reasons that GIS provide benefits for urban and environmental planners is their ability to integrate diverse data sets under a common spatial theme. This is not surprising since the organisation and management of urban and environmental data often has a strong spatial element to it. Further more, GIS are the only technologies that offer computerised spatial query and spatial analysis in an effective manner. Since an UIS may commonly be required to integrate diverse data sets and since urban and environmental problems have an inherently spatial nature, it is no surprise that GIS play such a key role in UIS (for more information, see (Craig, 1998; Kingston et al., 2000; Nedovic-Budic, 2000; Pickles, 1995; Tripathy, 2002; Ziliaskopoulos and Waller, 2000)).

This paper introduces a new approach to online information sharing between local administrations/institutions and the public. This approach, referred as a 'Community based Internet GIS', is a prototype Internet GIS model that aims to integrate a public oriented interactive decision support system for urban and environmental planning processes. A pilot application of this online

urban information system has been developed by the author for Shibuya City/Tokyo. The details of this approach and pilot project are presented in this paper.

2. COMMUNITY BASED INTERNET GIS APPROACH

Community Based Internet GIS Approach (CIGA) is a web based support system for collaborative decision making and discussion. It enables various users, such as the public, technicians and decision makers to obtain and share information interactively on their environs at different levels, scales, aspects and details. It also facilitates these users to participate in problem solving and decision making stages of the community based planning process (Figure 1).

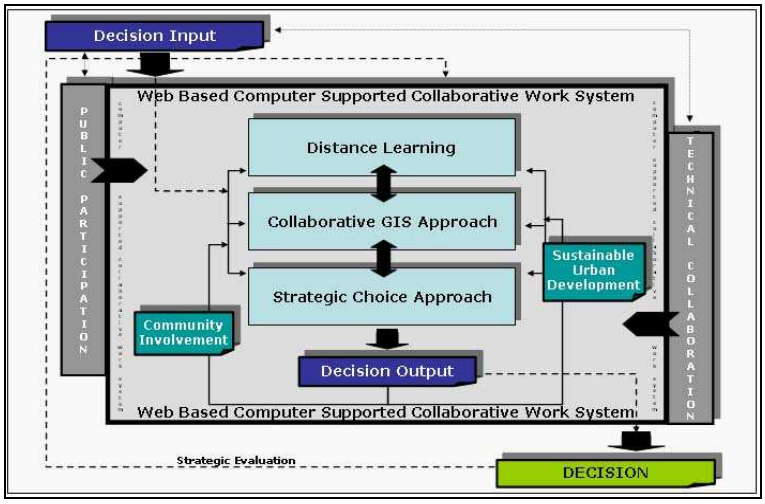

Figure 1: Community Based GIS Approach.

The system architecture of CIGA, therefore, comprises of a computer supported collaborative work system with clients and servers distributed across the internet as an open forum for all collaborators. System architecture of CIGA can easily accommodate all of the relational infrastructures between planning committees, community centres, and individual collaborators. These infrastructures also enclose transparent, secure, fast and cooperative network configurations.

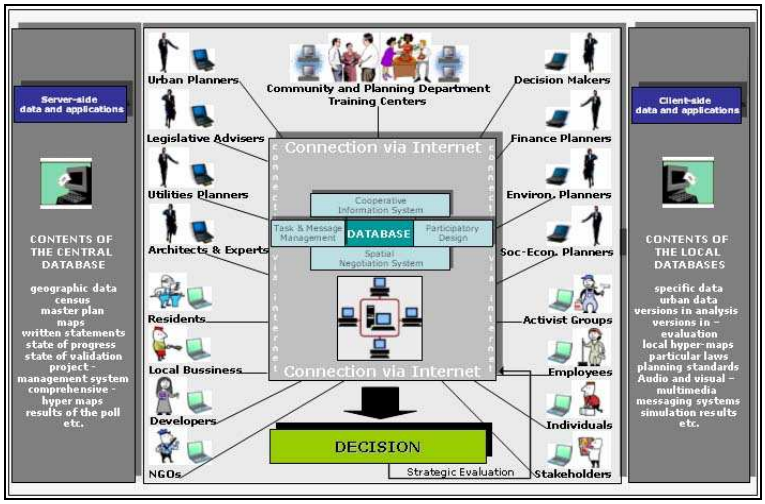

Figure 2: System Architecture of CIGA

Collaborative system architecture includes both infrastructures and specific applications for supporting collaboration. CIGA decomposed the functionality of collaboration systems into smaller functions, because of the relative newness and complexity of these systems. Like in the other basic models with multiple phases, feedback from subsequent phases is used to modify the results from the previous phases. The system constructs the trio of communication, collaboration and coordination among all of the participants (Figure 2).

CIGA is comprised of 'problem' and 'solution' stages. Both of the stages are connected through a series of five sections and fourteen steps (Figure 3). The first stage, problem stage contains various e-learning tools to raise awareness of the public on the system and planning issues that they are facing. Moreover, at this stage, the system endeavours to give basic education on environment, planning and decision making in a collaborative manner. This stage supports community based decision making by offering new approaches. It assists the public in better understanding, forecasting and visualizing the consequences of alternative allocations of their environs. This is accomplished through the application of information technologies, such as, GIS, image, multimedia, interactive and other computing technologies, coupled with professional planning assistance and training.

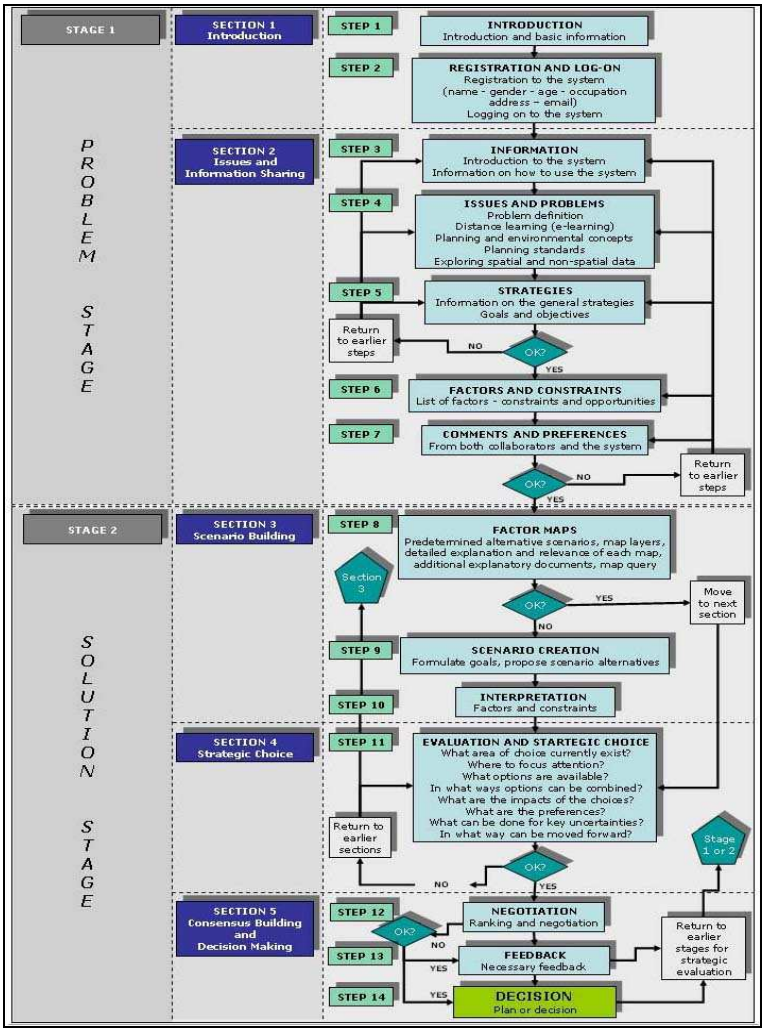

Figure 3: System Flow Chart of CIGA

The second stage of CIGA is the consensus building and solution stage and it contains an interactive and collaborative problem solving process. This is the stage to develop and evaluate scenario alternatives and give strategic decisions. Spatial decision support systems are often designed specifically to address semi structured problems. They often lack support for collaborative decision making, for this reason, CIGA accommodates collaborative GIS (for more information, see (Faber, 1997; Sapient, 2000)) and decision tools to support the decision making process. The solution stage of CIGA employs new tools, which are needed to form explicit links between criteria space and the geographic space that is being managed. Planning problems often result from the distributed and uncoordinated land use management practices of individual decision makers. Taken together, they cause significant environmental impacts and develop feasible and politically acceptable solutions to such problems. It is often necessary to foster cooperation and consensus among a diverse set of special interest groups who have overlapping sets of objectives. Participants discuss their opinions on the specific cases and try to reach a solution at the CIGA's consensus building and decision making section (for more information on CIGA, see (Yigitcanlar, 2002; Yigitcanlar and Okabe, 2002; Yigitcanlar and Sakauchi, 2002)).

3. SHIBUYA CITY INTERNET GIS PILOT PROJECT

The preliminary goal of this research is to develop a prototype urban information system and test it on a pilot case. The first stage of CIGA has been developed and it has recently been applied to a pilot project in Tokyo to test its strengths and weaknesses. Shibuya city has been chosen as pilot project field because of its environmental problems, mixed land-use and dense population. This pilot project has become online on the web on 01 July 2002 at http://kanagawa.csis.u-tokyo.ac.jp. Shibuya City Internet GIS pilot project aims to provide an easy access to urban and environmental data and to create environmental awareness among the public.

In this pilot project a system for accessing the information in the database via the internet is set up. The system uses Internet Map Server technology (IMS) to enable the concurrent presentation of the text information and map images (for more information, see (Harder, 1998; Plewe, 1997)). The system permits viewing the data from anywhere in the world, using popular web browsers such as Microsoft Internet Explorer and Netscape Communicator. Participants can view the map of the city, perform zoom and pan operations to assist in visualisation and navigation, ask such questions/queries and then make suggestions about specific features identified from the map. All user input is stored in the web access logs and is then used for future analysis and feedback into the planning process. In this manner a community database is created, representing a range of views and feeling about environmental and planning issues in the city.

3.1 Map Components and Database

Spatial data for Shibuya (i.e. quarters, transportation, historical layouts, natural resources, public buildings, green spaces, main infrastructure networks and etc.) were obtained from Tokyo Metropolitan Municipality and Centre for Spatial Information Science at the University of Tokyo. The projection of the selected data was converted into the UTM-34N system using ArcINFO. All these data were loaded into ArcIMS after file format conversion. The database contains additional text information about land-use types, demographic, social and economic structure of Shibuya. Text information of these datasets was compiled from the local administrations.

3.2 Internet Map Server

To enable the browsing of the data via internet, one server computer was set up and connected to the internet at the Centre for Spatial information Science at the University of Tokyo. As an internet map

server, one of the most popular Internet GIS products ESRI's Internet Map Server (ArcIMS) has been used for distributing GIS functionality over the web. As a GIS extension, it enabled to put maps and interactive mapping applications on the web. This extension has been employed to create information services based on dynamic maps and GIS data. A simple, three step process created these maps for the web that has interactive GIS functionality. ArcIMS generated web page content and scripts that provide the functionality for the site. This process uses a wizard and one of the three predefined templates - one HTML and two Java based viewers - that come with ArcIMS. These templates, as well as many other aspects of ArcIMS, are fully customizable (for more information, see (ESRI, 1997)).

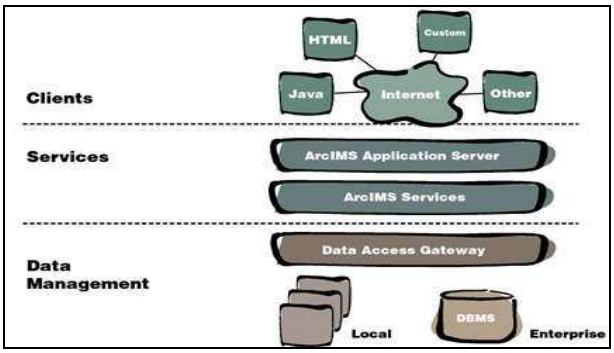

Figure 4: Architecture of IMS (ESRI, 2002)

The customization language for ArcIMS, Arc Extensible Markup Language (ArcXML), is one of the most powerful aspects of ArcIMS. It is a derivative of XML and a relative of HTML, but unlike HTML, ArcXML is a meta markup language that describes structured data content rather than display information. ArcXML files are editable text files that have an AXL extension. The requests and responses made by clients, middleware, and servers, as well as map and viewer configuration files, are written in ArcXML (for more information, see (Taig, 2000)). ArcXML has been utilised in customisation of Shibuya City Internet GIS project web site.

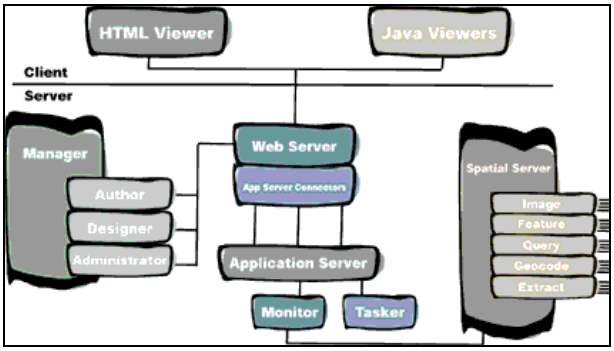

Figure 5: Components of IMS (ESRI, 2002)

ArcIMS contains four applications: Author, Administrator, Designer, and Manager. Author, Administrator, and Designer has been used sequentially to quickly set up Shibuya City Internet GIS web site. Author created an AXL file that is used by Administrator to start a MapService. The MapService was used by Designer to generate the web site. Manager, available on Windows 2000 server, is a web based application that incorporates Author, Administrator, and Designer for remote use of ArcIMS. Figures 4 and 5 illustrate this basic architecture and components of IMS.

3.3 Using the System

The users of the database first activate a web browser on a computer connected to the internet. The browser needs to be configured to accept Java applets. The URL of the initial web page of the database is: http://kanagawa.csis.u-tokyo.ac.jp (as of July 2002). When users first enter the site, after an initial welcome window, they are prompted to fill in a profile. This was seen as an essential part of the system design as it could be used to build up a database of users to help validate responses and analyse the type of people who were using the system. The main page contains; map, legend, tool buttons, and query frame (Figure 6).

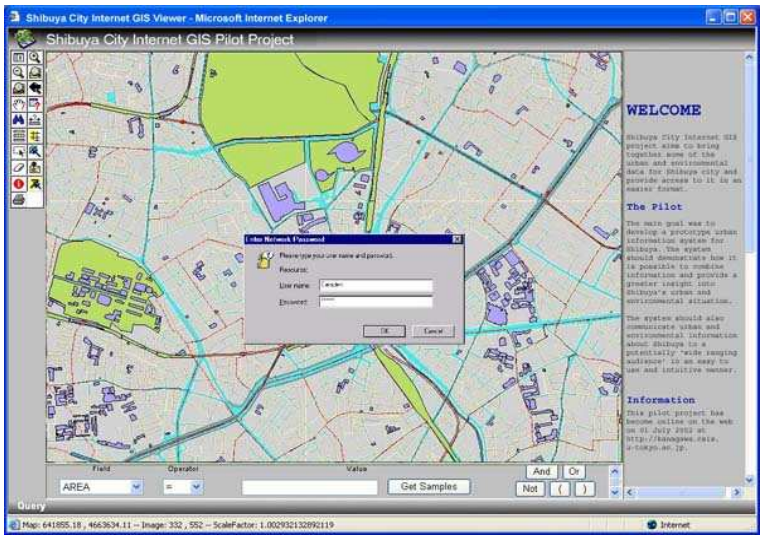

Figure 6: Webpage for Accessing the Shibuya Database

There are two sections in the first stage. The first section of CIGA is the introduction section where collaborators get basic information about the system and log on to it by their member profiles. Membership only requires basic information such as, name, gender, age, occupation and contact information. The CIGA system is an open platform for everyone who wants to be apart of the problem solving process. It develops a comprehensive integrated information sharing platform for the collaborators. Together with the components, CIGA creates and promotes awareness on planning issues, relationships, virtual community and trust online. CIGA even can be seen as an open communities' network that accommodates real time processing and establishes online relationships that strengthen the environmental protection and decisions of local governments, institutions, communities and individuals.

The second section is the issues and information sharing section and this section contains fundamental introduction of the system. It incorporates text and graphic based information on general strategies about the case studies, spatial and non spatial data, and planning standards. Collaborators can view the list of factors, constraints and opportunities, and comment on existing preferences at the final step of the second section (Figure 7 and 8). If the collaborators are confident enough to understand different facet of the problems and existing conditions, and have enough knowledge to be able to cope with them, then they can continue to the next section. Otherwise they can go back to the earlier steps to gain the knowledge to continue further sections of the CIGA process.

Although the development of the second stage has not been completed and it has not been applied to this pilot project yet, explaining this stage might give some clue how this online system will work

when it is fully utilised. The second stage of CIGA is solution and consensus building stage and it contains an interactive collaborative solving process. There are three sections in the second stage. The third section is the scenario building section. At this step, map layers can be switched on and off and detailed text based information can be viewed by the collaborators. Moreover, predetermined scenarios and additional explanatory documents can be studied to understand the situations and solution alternatives. If collaborators do not want to create their own scenarios, they can move on to step four and run the evaluation model for the predetermined scenarios by the system or by other collaborators. Otherwise, they can proceed to the next step to propose their own alternative scenarios. After they create their scenarios, they can reinterpret factors and constraints and then move on to the next section.

Figure 7: Shibuya City Internet GIS Pilot Project

The fourth section is the strategic choice section, where created scenarios are evaluated by using the strategic choice approach (for more information, see (Friend, 2002; Friend and Hickling, 1997)). If collaborators are satisfied with the evaluated results, they can proceed to the next section. If not, they can return to the earlier sections for feedback and scenario correction.

Figure 8: Shibuya City Internet GIS Pilot Project

The fifth and final section of the CIGA is the consensus building and decision making section. At this section interactive negotiation between all collaborators, and ranking between all chosen scenarios occur until a consensus is built between them. However, developing a consensus between collaborators can be very difficult and time consuming. If further feedback is necessary, collaborators return to the earlier stages of CIGA for strategic evaluation and feedback. Before the final decision is approved, entire process is required to be reviewed one more time for strategic evaluation.

CIGA is a continuous and dynamic decision support process. Consequently, the decisions have to be evaluated in an iterative and cyclical way until all uncertainties are removed. This kind of approach can only facilitate smart decisions by having an open platform for all contributors, providing consensus among them and other interest groups, adopting user friendly technologies, and accommodating strategic decision support systems.

Collaborators, in the context of problem solving, represent several interests and bring to the negotiation table different types of training, levels of education, experience with computing technologies, and familiarity with the problems that are being addressed (Figure 9). This dissimilarity of knowledge can have significant effects. In spite of their differences, these people often can not easily work together to devise solutions unless they have been trained to do so. That is why CIGA may become an important tool at the near future to overcome the conceptual and technical barriers that inhibit the effective use of innovative technologies for urban planning problems.

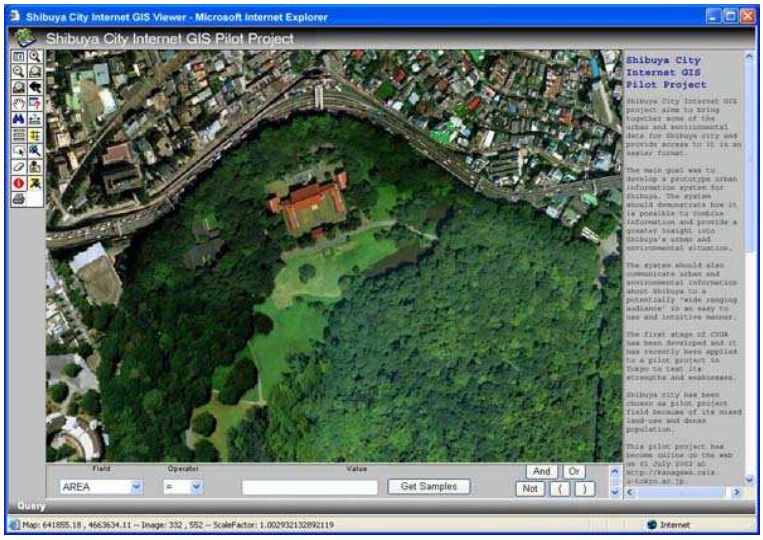

Figure 9: Shibuya City Internet GIS Pilot Project

4. CONCLUDING REMARKS

Integration of community based interactive decision making and online discussion support systems to planning mechanisms can help to create smart urban environments and communities. There are several major benefits of this proposed approach. CIGA supplies equal access to data and information for users over internet. It endeavours to encourage individuals to share their opinions on their environments, helps communities maintain a smart and healthy balance of urban growth, aids in conservation of natural resources, cultural identity by enhancing citizen consciousness and also helps in bridging the gap between decision makers, technicians and the public. CIGA accommodates an equitable representation of diverse views, preserves contradiction, and endorses the role of individuals

and communities in creation and evaluation of development plans and strategies by promoting citizen participation in urban planning. It offers powerful tools to provide information and support decision making in sustainable urban development, planning and management. Finally, CIGA supports the appropriate use of analytical tools and data sets in policy making and planning to predict and examine the possible short and long term outcomes on the urban areas.

The preliminary results of the pilot have shown that online urban information systems have potential to catch public interest in preparation of the urban development plans. The system demonstrates how it is possible to combine information and provide a greater insight into Shibuya's urban and environmental situation. The system also communicates urban and environmental information to a potentially wide ranging audience in an easy to use and intuitive manner. The ability to instantaneously update the database and profile users online was seen as one of the most useful advantages of the system over the traditional techniques. The online system has a long residence time allowing people to use the system anytime, anywhere. The public do not need to attend a meeting at a particular time or place. This is often the single most inhibiting factor in participating via traditional methods. The system allows faster collation of results from log files and the web site can be used to disseminate results and feedback.

Clearly there is a need to improve the public access to urban and environmental information, and encourage collaborative decision making. Online UIS offer a variety of tools and technologies to assist the management and use of urban and environmentally related data and information, and hence can be used as a tool to help to achieve this goal. If we are to strive to achieve the most efficient form of a sustainable information society, UIS, their tools and results should attract the interest of as wide an audience as possible. The role of the internet, public participation and the development of Internet GIS are important factors in taking this potential further. Generic ideas presented in this paper are useful and may help people who are developing online UIS and communities that are willing to integrate these systems.

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